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Designing a Warehouse with RFID and Firebase Based Android Application

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Abstract

Information sharing is a vital part of a hassle-free supply chain. And this research was about information sharing between the supply chain terminals and automation of the warehouse using Radio Frequency Identification (RFID). Here input and exit were associated with RFID to count the incoming and outgoing lots of product for keeping track of the inventory status. A firebase database android app was compiled to connect the warehouse with the retailers and manufacturer. The warehouse could manage the orders of the retails and assign orders to the manufacturer and retailers could set orders to warehouse and manufacturer could receive orders from a warehouse. For further simplification warehouse stock information was made exposed to the retailers. The process would pave an apparel concept not only to make the information sharing in the supply chain more simple, spontaneous and uninterrupted but also to rehash the warehouse management easier and accurately performable.

Keywords: *Supply Chain, Warehouse Information System, RFID, Firebase based Android Application*

INTRODUCTION AND LITERATURE REVIEW

With the increase in popularity of social media sites over the past few years, there has been a move towards using these platforms in many business sectors to manage and promote business in areas such as brand awareness and client and partner management. It is shown how social media are used for recruitment of global supply chain managers [1]. To facilitate smooth exchange of information among the project stakeholders, an ontology-based distributed web service framework is very important which uses web portal system through which multiple information sources and applications can be accessed, retrieved, and integrated [2]. There was a time when organizations needed pen and pencil to note down inventory related data and later on added in a spreadsheet which they had to show to the superiors. But manually counting inventory when they were stored in the warehouse and the time they were delivered to the customer caused many problems because of physical counts, poor communication, human error etc. For small business it was very risky to have an error in 3 its operating system. Now organizations are concerned about it and as a precaution for it they have started using RFID based and computerized warehouse management systems.

The project proposes the use of RFID in entry and exit gate of the warehouse where one type of finished goods will be stored and a Firebase Android application for making the warehouse status visible and ordering process easy for retailers, warehouse managers and manufacturers. Nowadays in Bangladesh warehousing is no longer the soloed operation ignored by those in the supply chain who are not directly linked within the four walls of a

warehouse. Companies are expecting more from their warehouse. They demand greater visibility into the ordering system, inventory, and task statuses inside the warehouse. It will decrease the situations of skirmish or misunderstandings and the bonding among the supply chain partners will be stronger.

A model was proposed which collaborate theoretical and pragmatic studies of competitive strategy, inter-organizational IT along with supply chain management by supporting in capacity, operational flexibility based on internal and external analysis. ILP was applied to count the distance of forklifts and RFID, Case-based Reasoning (CBR) etc. determined policy of route optimization [3]. AOP was applied on current WMS to simplify system structure, increase agility, and maintainability including logics rearrangements of the design in [4].

Harry K.H. et al. proposed that up and downstream supply chain could maximize activities linkage within the value chain using RFID based logistics process and supply chain distribution management system could be optimized when occupied by IT applications [5]. RFID cooperated in cost and human errors reduction and fulfilling market demand properly [6]. To manage the warehouse and make an efficient process different technologies; like- automatic identification of product using labels, scanning equipment used to identify, stock control techniques using back-office databases, picking the order in automated system etc. were used in [7]. The interrelationships within marketing performance, financial performance and customer satisfaction in Vietnam textile industry were shown employing fuzzy DEMATEL method along with IT [8].

Warehouse management is a combination of planning, monitoring, and application which was guided by task complexity (TC) and market dynamics (MD). The inputs of inventory were maintained using JAVA web application and MySQL database in [9]. Information sharing is the vital part of a hassle-free supply chain [10]. WMS depending on selected automatic identification technology is the merger of RFID [11]. Automatic identification, data capture technologies, and all WMS related process are adducted in the research. This research showed how data of 102 large Iberian firms from Spain and Portugal are used to improve the SCM performance [12]. A leading telecommunications service provider in Jordan used automated WMS for performance improvement [13]. Using Java Web applications and MySQL database Kanban development in inventory management was exhibited in the research [14].

The Objectives of this research is (1) to design a warehouse with RFID in entry and exit gate and (2) to design a firebase android application for retailer, warehouse manager and manufacturer. In the following section a warehouse with RFID in entry and exit gate is designed and then a firebase database android app was compiled to connect the warehouse with the retailers and manufacturer.

DESIGN A WAREHOUSE WITH RFID IN ENTRY AND EXIT GATE

The design of a warehouse with RFID in entry and exit gate is performed in the three steps: positioning RFID in the entry and exit gate, connecting RFID, display and arduino, and finally connecting and authenticating firebase project with android studio. These three steps are given as follows:

Positioning RFID in the entry and exit gate

The RFID reader module uses the SPI protocol for communicating with the Arduino board. The circuit of RFID and Arduino connection is shown in Fig. 1.

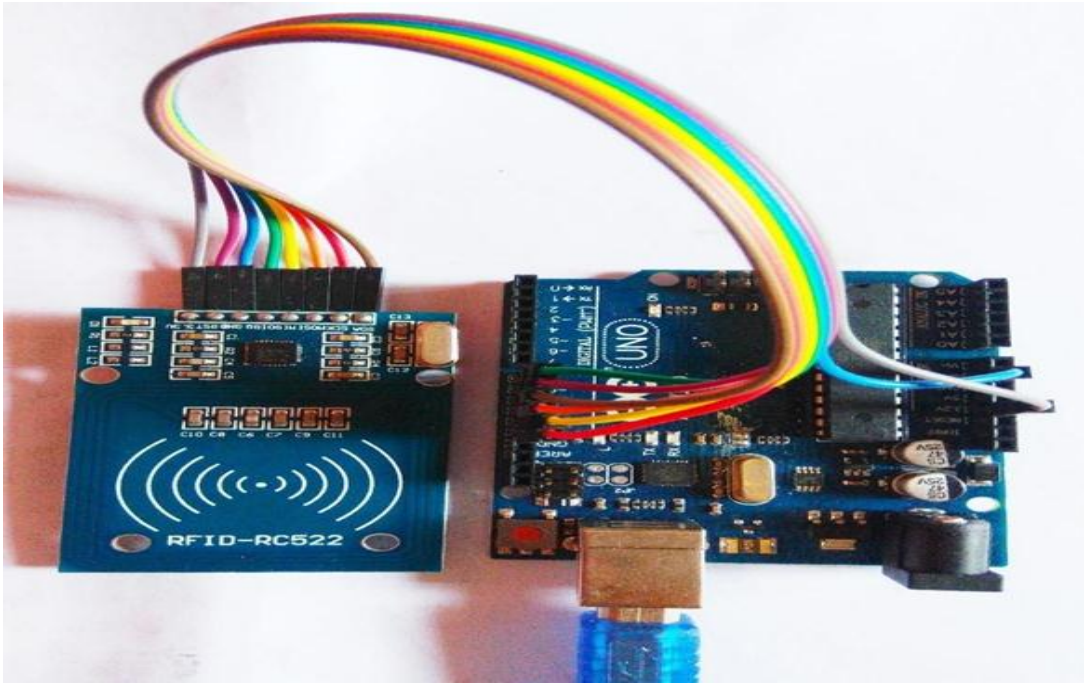

Figure 1: *RFID and Arduino connection circuit.*

After connecting the module, code for entry and exit gate is loaded on the module with the help of Arduino software**.**
As an example Arduino code for entry gate is shown as follows:

```
#include <SPI.h>
#include <MFRC522.h>
#include <LiquidCrystal.h>
#define SS_PIN 10
#define RST_PIN 9
MFRC522 mfrc522(SS_PIN, RST_PIN); // Create MFRC522 instance.
LiquidCrystal lcd(7, 6, 5, 4, 3, 2); // initialize the library with the numbers of the interface pins
#define buzzer 8 #define out A0 int stock = 100;
void setup()
{
 Pin Mode (buzzer, OUTPUT);
Serial. begin (9600);   // Initiate a serial communication SPI. Begin (); // Initiate SPI bus      mfrc522.PCD_Init ();   // Initiate MFRC522      lcd.begin (16, 2); // set up the LCD's number of columns and rows:      lcd.print ("* Ware House *");   // Print a message to the LCD.
Delay (2000); display ();
}
 void loop ()
{
// for outgoing ----------// if (analog Read (out)>500)
{stock = stock -10; sound (); display ();
delay(2000);
}
// for incoming ----------// if ( mfrc522.PICC_IsNewCardPresent()) // Look for new cards
{
stock = stock + 10; sound (); display ();
delay (2000);
}
}
void display ()
{ lcd.clear (); lcd.setCursor (0,0);
lcd.print("Stock: ");  lcd.setCursor(7,0);
lcd.print(stock);      return 0;
}
void sound ()
{
digital Write (buzzer, HIGH); delay (200);
digital Write (buzzer, LOW); return 0; }
```

Connecting RFID, Display and Arduino

For this research work 8×2 LCD display was used. The part 8×2 means that the LCD has 2 lines, and can display 8

characters per line. Therefore, a 8×2 LCD screen can display up to 16 characters at once. For connecting the LCD required hardware are Arduino, LCD Screen (compatible with Hitachi HD44780 driver), 10k ohm potentiometer, 220 ohm resistor, hook-up wires, and breadboard. For connecting LCD display with Arduino and RFID, a breadboard is used. A small however necessary step is wiring the potentiometer to the LCD to regulate brightness. The LCD and Arduino is wired up as shown in the Fig. 2.

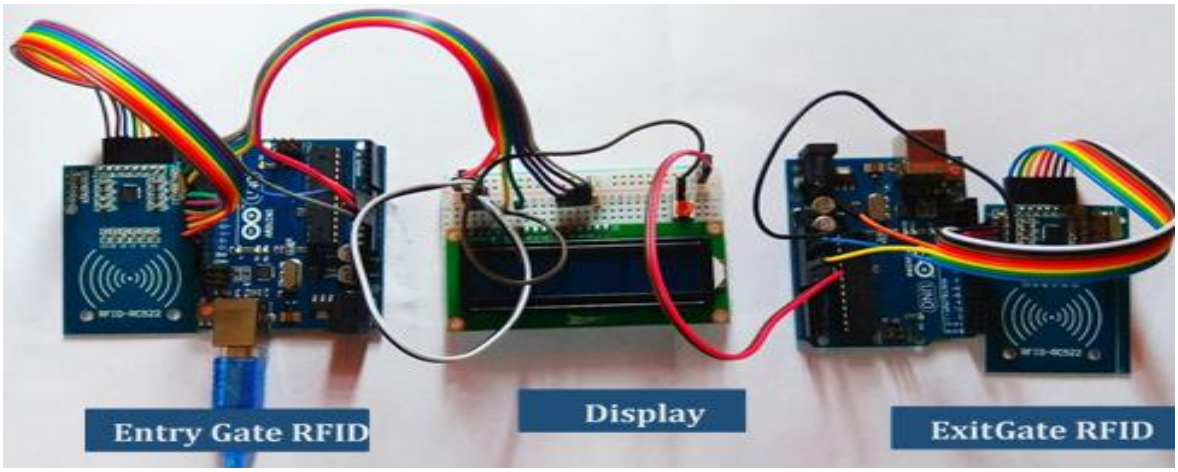

Figure 2: *LCD Display, Arduiono and RFID connection circuit.*

Connecting and Authenticating Firebase project with Android Studio

From the Firebase console at https://console.firebase.google.com/ a firebase project was created. By providing the name of the project, and the country for which it will be used, a project was created. To connect Android app to Firebase the Firebase Assistant is Android Studio the following steps were followed.

Step 1: Android Studio>Tools > Firebase to open the Assistant window.
Step 2: Analytics feature was expanded and a tutorial link was requested.
Step 3: 'Connect to Firebase' button was clicked to connect to Firebase and the necessary code was added by the Firebase Assistant to the app.
Step 4: For manufacturer, warehouse and retailer accounts were created in Firebase.

USE OF FIREBASE ANDROID APPLICATION

The use of Firebase android application are as follows:

Warehouse activity

The warehouse manager will have to log in to an existing account. To ensure that the system is working properly, he must match the inventory status with the display. If it matches, he will then check the pending orders from the retailer along with their locations. If the current inventory can satisfy the demand from the retailer, then he will accept the demand. The unit price will also have to be updated if it changes. Once the demanded products pass through the exit gate, that amount will be subtracted and the inventory status will be updated automatically.

When the inventory level will reach at safety inventory point or below of that, there will be a system for automatically placing an order to the manufacturer with the permission of the warehouse manager.

Retailer activity

If the retailer has no account, he will have to sign up to a new account and wait for the warehouse's confirmation. Or if an account exists, the retailer will log in and

check the inventory status and pricing policy. He will place an order if it brings a favorable result.

Manufacturer activity

After log in to account the manufacturer will be able to know about the inventory level at the warehouse and will be aware if there is an order from the warehouse. The manufacturer will also be able to see if the products are available at the right price in the warehouse. The transparent inventory status will also help him to forecast the demand in future.

The algorithm of activities of the retailer, warehouse manager, and the manufacturer is shown in Fig. 3.

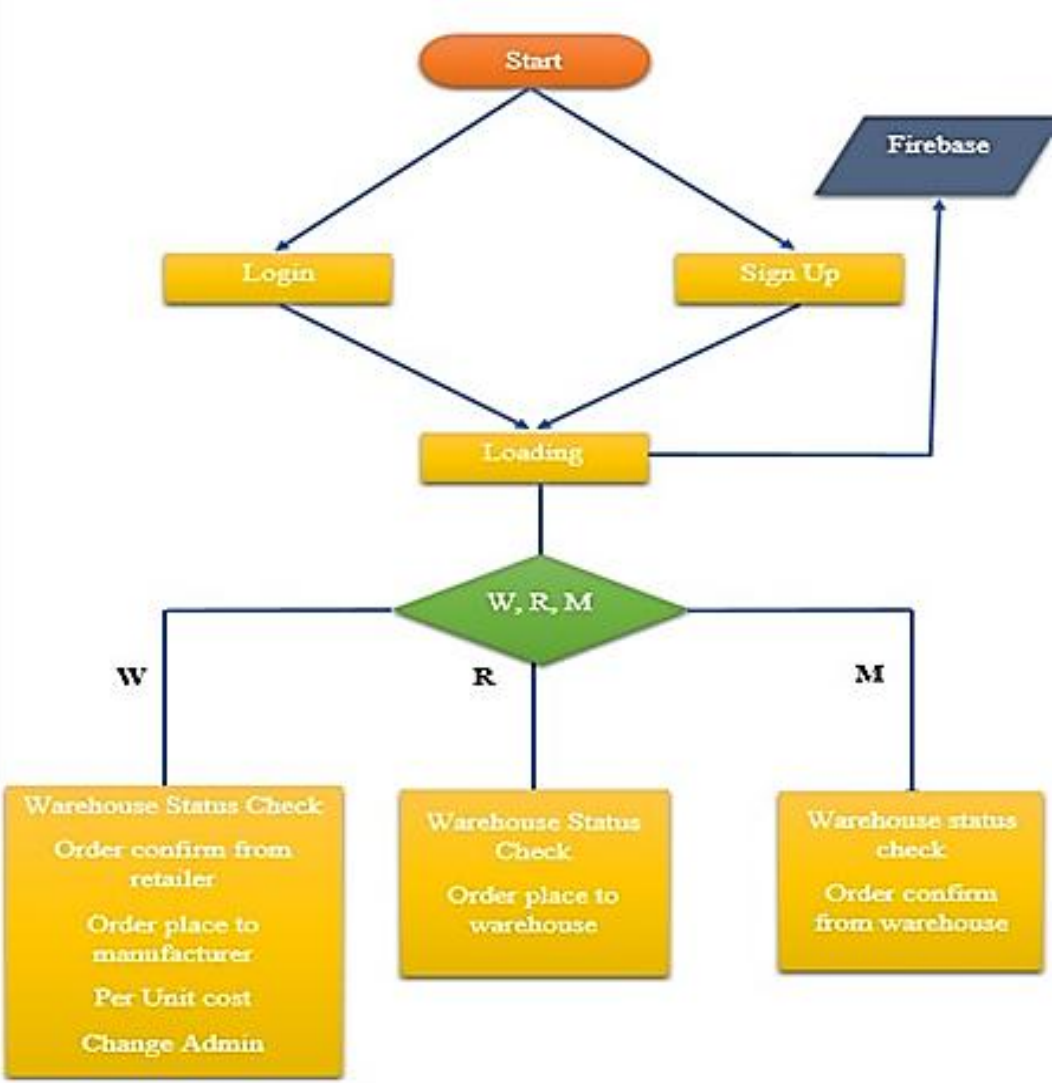

Figure 3: *Algorithm of the activities of the retailer, warehouse manager, and the manufacturer.*

RESULTS AND DISCUSSION

One of the end product of this research work is the Firebase Android app. The firebase android app works in a very organized fashion. It starts with retailer placing an order to warehouse which is shown in Fig. 4 as an example. Then, warehouse accepts the retailer's order. After that, warehouse places an order to manufacturer shown in Fig. 5. Then, the manufacturer accepts the warehouse order shown in Fig. 6.

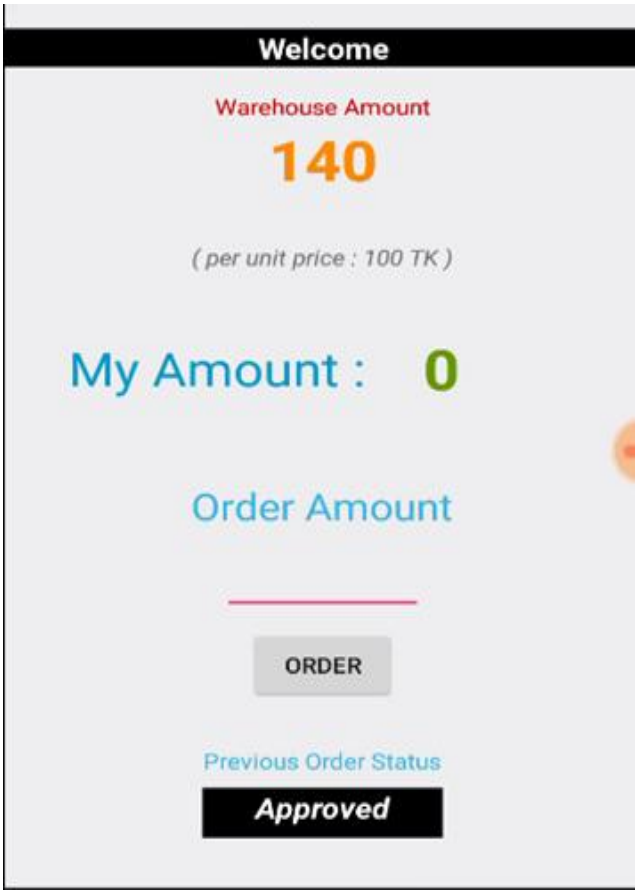

Figure 4: *Retailer Interface.*

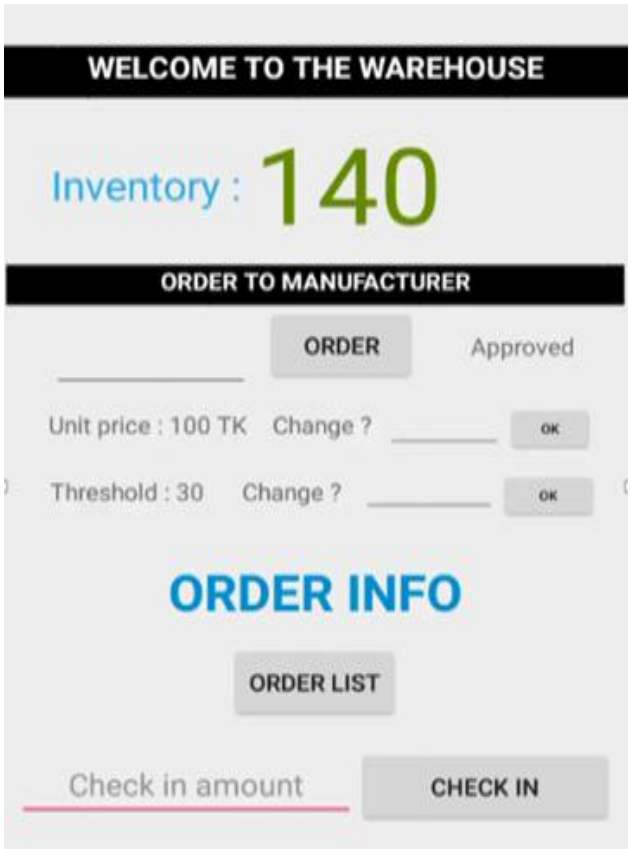

Figure 5: *Warehouse Interface.*

In this research work, it is shown that how RFID and firebase android app can work together to make the supply chain information sharing spontaneous. RFID is used in the warehouse to automatically count the units in stock and firebase database is connected with the RFID tag and count system. Firebase android app uses the database so that it can accurately display the amount in stock in the warehouse.

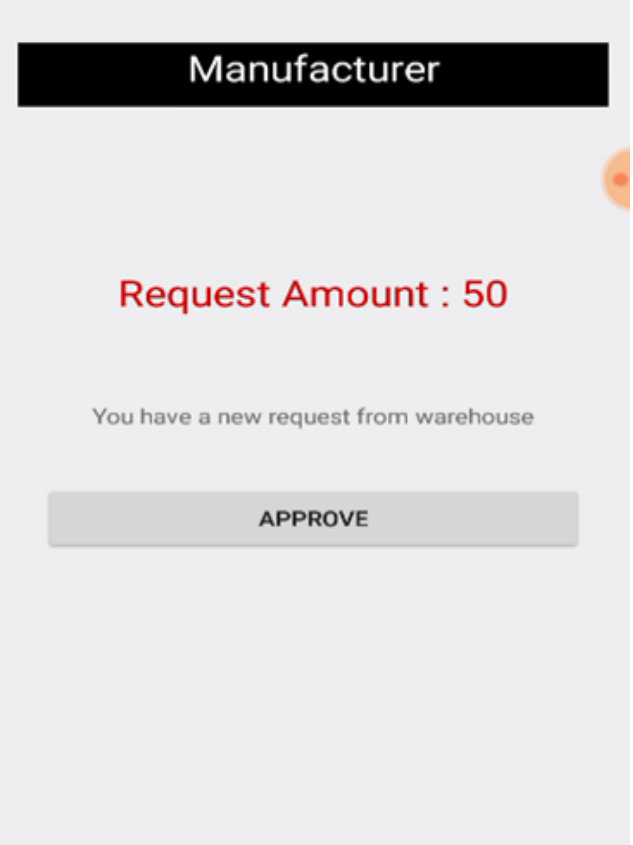

Figure 6: *Manufacturer Interface.*

Information sharing is a very important part of an efficient supply chain management. The stock of warehouse was maintained and reloaded by the manufacturer. But the job would become more convenient if the manufacturer gets order from the warehouse when there's a shortage of product in the warehouse ad able to accept or reject the order. For rejection, the warehouse could able to take the necessary steps to meet the retailer's order. So some opportunity cost could be reduced. On the other hand, knowing about the stock update of the warehouse while ordering, the retailer could order the available amount of product or take precaution if the product was not available. An android based app could serve the purpose.

The firebase database could be maintained by the warehouse which could accept the orders from retails or reject the order. Besides an RFID based automated warehouse could maintain the stock count more accurately than a manual system. No manual count of the lots would be necessary. To make the supply chain more feasible, operative, active and efficacious the information sharing via android app and automation of the warehouse using RFID and firebase database could be effective.

CONCLUSION AND FUTURE WORK

Information sharing is the vital part of a hassle-free supply chain. And this research was about information sharing between the supply chain terminals and automation of

the warehouse using RFID. Here input and exit were associated with RFID to count the incoming and outgoing lots of product. Besides comparing the data could give the inventory status. A firebase database android app was compiled to connect the warehouse with the retailers and manufacturer. The warehouse could manage the orders of the retails and assign orders to the manufacturer. Besides using the same app retailers could set orders to warehouse and manufacturer could receive orders from a warehouse. For further simplification warehouse stock information was made exposed to the retailers. In short, the process would pave an apparel concept not only to make the information sharing in the supply chain more simple, spontaneous and uninterrupted but also to rehash the warehouse management easier and accurately performable.

The use of RFID in warehouse makes the inventory management system easier but gives no information about the storage location or the optimal storage space of inventory. In future we intend to add all the above mentioned in our real time data base system. The system is designed for the organizations where manufacturer, warehouse and retailer are major supply chain partners and where the retailer's shops are located near to the warehouse so that distribution is not a major issue. In future we plan to overcome these limitations by introducing a database system where more features will be developed for other supply chain partners like distributors, customers.

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BIOGRAPHIES

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